

## Description

# HYDRAULIC TIPPING ARRANGEMENT FOR A TRUCK

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation patent application of International Application No. PCT/SE02/00982 filed 22 May 2002 which was published in English pursuant to Article 21(2) of the Patent Cooperation Treaty, and which claims priority to Swedish Application No. 0101944-7 filed 1 June 2001. Both applications are expressly incorporated herein by reference in their entireties.

### BACKGROUND OF INVENTION

### TECHNICAL FIELD

[0002] The present invention relates to an hydraulic arrangement for operating a load body on a heavy vehicle in which the load body is connected to the frame of the vehicle by way of at least one articulated joint that enables the load body

to tip, and to be moved between a lowered transport position and a raised tipping position.

## **BACKGROUND**

[0003] A heavy vehicle such as a dumper truck that, for instance, carries gravel in a load body typically discharges its load by tipping the load body. The load body, which is supported at the rear end of the vehicle, can usually be tipped to a maximum of 60° to 70°. Tipping is performed either by a directly acting lifting cylinder or indirectly via a knuckle joint arrangement that entails a system of linkages coupled to the load body and vehicle frame, and which is actuated by lifting cylinders.

[0004] There are many requirements to be taken into account when designing a tipping system. The system should, for example, be efficient; that is to say, it should rapidly tip the load and rapidly return to the home or transport position. It is advantageous to be able to use "small" hydraulic cylinders that have a short stroke and moderate hydraulic pressure, since this means that the hydraulic system can be of a more simple design and does not need to function with large flows of hydraulic fluid.

[0005] Some of the requirements, however, conflict with one another. A short stroke, for example, requires the produc-

tion of large forces, and in turn, big cylinders. In such a configuration, the tipping geometry has great significance in the interplay of resulting forces.

[0006] If a point of action used for a tipping cylinder between the vehicle frame and the load body is applied essentially at the greatest distance from the load body bearing points on the frame, the force required of the piston cylinder is relatively low, but the piston cylinder then needs to be long. Use is therefore often made of telescopic cylinders that extend in a number of stages. This again becomes a slow process since the cylinder's large diameter is also offset by large oil flows per unit of time. A telescopic cylinder is moreover mechanically sensitive or vulnerable, since it has large sealing surfaces with increased risk of leakage.

[0007] Another example of cylinder mounting is to place single cylinders on either side of the load body; that is to say, with points of action shifted towards the load body bearing point on the vehicle frame. Since this shortens the lever arm, the power required from the tipping cylinders is increased.

[0008] United States Patent No. 4,488,756 describes a tipping system having a master cylinder and two secondary cylin-

ders that act in different directions. The master cylinder is fitted at the front edge of the load body and the two secondary cylinders are fitted with their point of action between the two ends of the load body. The master cylinder is intended to act during a first phase of the tipping in which the power requirement is greatest. This solution requires the hydraulic system to become relatively complex.

#### **SUMMARY OF INVENTION**

[0009] An object of the present invention is to provide a cost-effective and reliable hydraulic arrangement that is capable of rapidly performing an up-and-down tipping movement.

[0010] To achieve this object, an hydraulic arrangement configured according to the invention includes an hydraulic cylinder assembly, which comprises (includes, but is not limited to) at least two piston cylinders, each of which works in its own direction and which are hydraulically and mechanically coupled to one another. By means of this design, it is made possible to optimize the pressure area in two or more stages during a tipping cycle so that the hydraulic system is simple and hydraulically efficient, thereby reducing the cycle time for a tipping movement.

[0011] According to an advantageous variation of the invention,

piston cylinders of the hydraulic cylinder assembly are arranged parallel and work in opposite directions. This design provides a compact and mechanically solid unit.

[0012] According to yet another advantageous embodiment (variation) of the invention, the hydraulic cylinder assembly comprises three piston cylinders, of which two work in the same direction and the third piston cylinder is located in the same plane between the two piston cylinders. This provides a unit that can easily be assembled and disassembled.

[0013] The pistons of both of the outer piston cylinders are suitably connected directly to the vehicle frame and the piston of the middle piston cylinder is suitably connected to the load body.

[0014] Further advantageous embodiments of the invention will become clear to those persons skilled in these arts in view of the following description.

#### **BRIEF DESCRIPTION OF DRAWINGS**

[0015] The invention will be described in more detail below with reference to exemplary embodiments as shown in the accompanying drawings of which:

[0016] Fig. 1 is a perspective view showing a rear part of a heavy vehicle having an hydraulic arrangement configured ac-

cording to the teachings of the presently disclosed invention;

[0017] Figs. 2–4 are a series of side views showing the hydraulic arrangement of Fig. 1 in three different working positions (contracted, partially extended, fully extended);

[0018] Fig. 5 is a schematic diagram illustrating exemplary operation of an hydraulic arrangement configured according to the teachings of the present invention.

#### **DETAILED DESCRIPTION**

[0019] A heavy vehicle 10, as exemplarily shown in Figure 1, is provided with a load body 11 that is connected to a frame 12 of the vehicle by articulated joints 13 that enable the load body 11 to tip. Figure 1 shows the load body 11 in an intermediate position between a lowered, transport position and a fully raised, tipping position. Operation between these positions is performed by means of an hydraulic arrangement comprising an hydraulic cylinder assembly 14, arranged at the front end of the load body, and an hydraulic system.

[0020] In the exemplary embodiment, the hydraulic cylinder assembly 14 comprises two outer parallel primary piston cylinders 15, 16 and a secondary piston cylinder 17 located between these cylinders and oriented in the same

plane therewith. All of the piston cylinders are hydraulically and mechanically coupled to one another; the piston cylinders 15, 16 working in the same direction and the piston cylinder 17 working in the opposite direction. It is naturally possible to use more or fewer piston cylinders in such an hydraulic cylinder assembly.

[0021] Figures 2 to 4 show the hydraulic cylinder assembly 14 in three different operative positions. Figure 2 shows the primary piston cylinders 15, 16 and the secondary piston cylinder 17 in a retracted (contracted) position. Figure 3 shows the primary piston cylinders in the extended position corresponding to Figure 1. Figure 4 shows both primary piston cylinders 15, 16 and secondary piston cylinder 17 in extended positions.

[0022] Figure 5 provides a schematic diagram of an hydraulic system utilizable for the operation of the hydraulic cylinder assembly 14. The system is simplified in that it only shows the one primary piston cylinder 15, which is provided with a piston rod 15a having a first internal passage 18 into a compression chamber 19 of the piston cylinder. A second internal passage 20 into the expansion chamber 21 of the piston cylinder is also provided. The secondary piston cylinder 17 is coupled in parallel with the primary

piston cylinder 15 in such a way that the compression chamber 19 of the primary piston cylinder 15 is connected by way of a fluid line 22 to the compression chamber 23 of the secondary piston cylinder. The expansion chamber 21 of the primary piston cylinder 15 is connected by way of a fluid line 24 to the expansion chamber 25 of the secondary piston cylinder.

[0023] An hydraulic pump 26 is designed to draw hydraulic fluid from a tank 27 and to deliver the pressurized fluid to a valve unit 28. On expansion of the piston cylinders, a two-way valve 28a forming part of the valve unit 28 (as shown in Figure 5) stops; the piston cylinders thereby being simultaneously pressurized on the expansion side and the compression side by way of the branch lines 29, 30. Since the piston area is greater on the expansion side than on the compression side, the piston rods will be pushed out. On compression of the piston cylinders, the two-way valve 28a of the valve unit 28 is switched over so that the branch line 30 is connected to the tank 27 so that the pressure on the expansion side of the pistons becomes zero. The excess pressure is maintained on the compression side of the pistons which causes the piston rods to be drawn in. In this way a tipping operation can be



performed rapidly and efficiently.

[0024] If the hydraulic cylinder assembly comprises two primary cylinders and one secondary cylinder, the area of the secondary cylinder can be adjusted so as to limit maximum hydraulic pressure required for the tipping movement. For example, the two primary piston cylinders may function within a tipping angle range from 0° to approximately 30°. The force (expressed as a % of the load) will then have fallen from approximately 47% to approximately 33% of the weight of the load body (which means that the requisite oil pressure has been reduced from 100% to 70%).

[0025] The secondary piston cylinder 17 may be connected to the load body by way of a U-link, either with or without a piston cylinder enabling the U-link to be swung away from the load body, as is described, for example, in SE 307898.

[0026] It should be appreciated that the invention is not confined to the exemplary embodiments described above and shown in the drawings: a number of further variants and modifications being feasible without departing from the scope of the claims. For example, the heavy vehicle may consist of a trailer that can be connected to a traction vehicle.